BOULDER DAM TURBINES

By FRANK RANZ

EARLY this year the four largest hydraulic turbines ever built will go into operation at Boulder Dam. Each of these turbines is rated at 115,000 horsepower, with a discharge capacity of 270 million gallons of water daily—nine times the average daily consumption of the entire City of Columbus.

All four turbines have been designed and manufactured for the federal government by the Allis-Chalmers Company of Milwaukee. They will be the first large units of the Boulder Dam Power Plant, which will ultimately contain fifteen 115,000 horsepower units and two units of 55,000 horsepower each.

The size of the large turbines is the greatest that could economically be constructed and transported. Their design was determined mainly by the average head of water that will prevail at Boulder Dam. As designed, the turbines will operate at heads varying from 420 feet to a maximum of 560 feet and will develop full capacity at 475 feet.

To provide an adequate supply of water for the turbines, the intake of each spiral casing is ten feet in diameter. The spiral casing itself is divided into six sections, which have a total weight of 450,000 pounds. One section, the second from the intake, alone weighs 150,000 pounds.

The design of the spiral casing was one of the major problems encountered in manufacturing the turbines. The usual proportion of flange and wall thickness was found to be unsatisfactory, and the proper dimensions were determined only after a series of special tests. The tests were made upon model flanges about one fourth the actual size.

When completed, the sections of each casing were assembled on the shop floor and subjected to the rigid tests specified by the Government. Specifications called for each turbine to be tested under a hydrostatic range up to 500 pounds per square inch. Thirty-six micrometer gauges were placed around and about each casing to measure the strain on the casing walls under pressure. All four turbines met the requirements of the Government in all particulars.

Elaborate tests were also made in determining the

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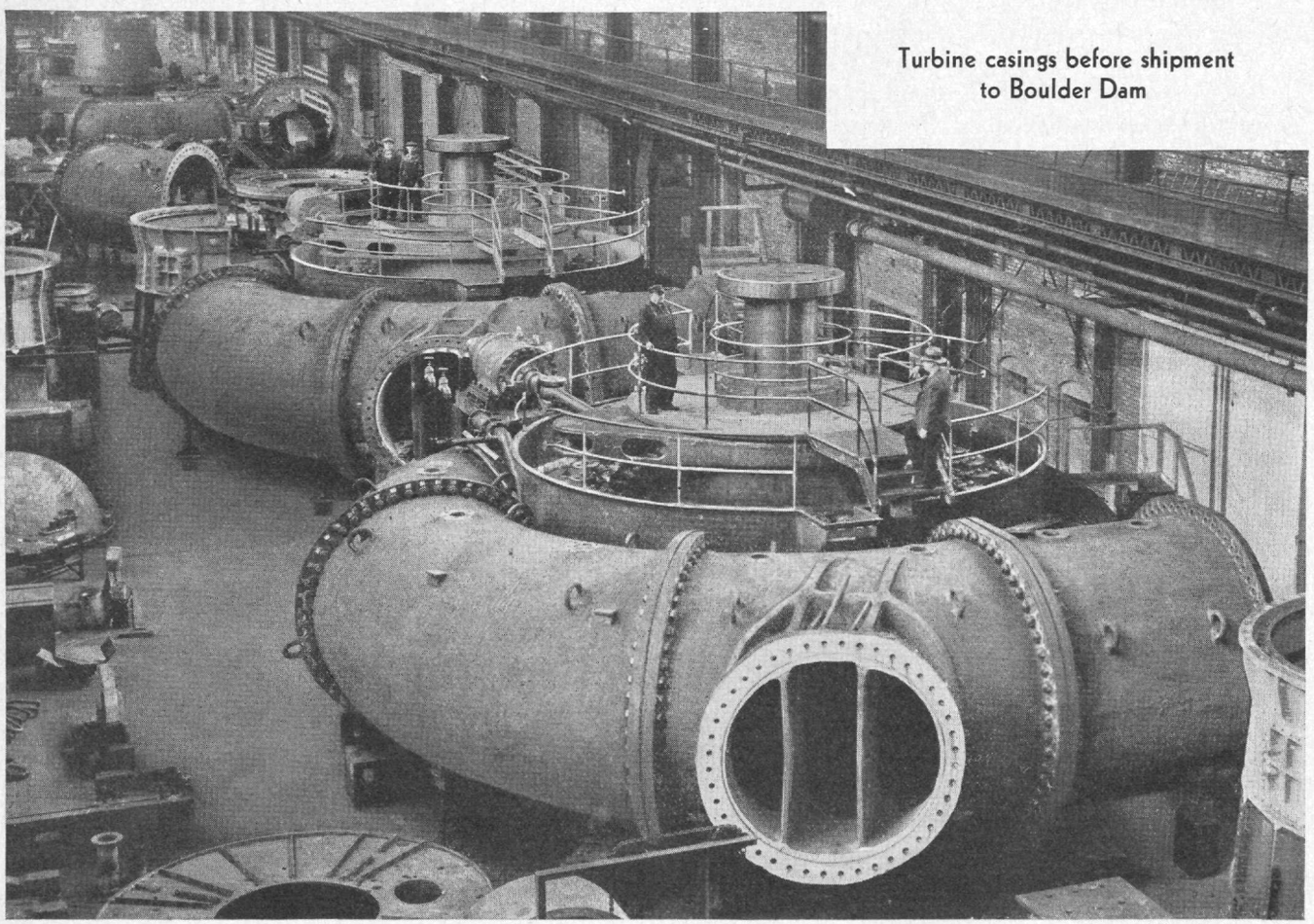

Turbine casings before shipment to Boulder Dam

Courtesy Allis Chalmers Co.

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design of the rotor, or runner, as it is technically known. The design had to be changed after the manufacture of other turbine parts had begun. Original specifications called for a speed of one hundred and fifty revolutions per minute. However, before the runners were cast the City of Los Angeles decided to adopt sixty-cycle current for their electric system in place of the old fifty-cycle. This necessitated designing a runner to operate at 180 rev. per min. in a turbine designed for 150 rev. per min. Tests were made with model runners to determine the proper design. The results were so satisfactory that the performance of the new runner is expected to be well above the guarantees made for the 150 rev. per min. runner.

After the turbines were tested on the shop floor, they were torn down for shipment. Each casing section filled an entire railway flat car. To get each turbine to its destination required twenty-six cars. The total weight of each turbine is roughly a million and a quarter pounds.

At Boulder Dam the turbines are being set in concrete. While the concrete is poured, a pressure of two hundred and fifty pounds is maintained in the turbines. This will greatly reduce the strain on the turbine walls under operating conditions.

The turbines are set farther below the tail-water level than would ordinarily be necessary. Because of the great amount of silt in the river bed, it is expected that the channel below Boulder Dam will be washed out lowering the tail-water level twenty-five feet in the next ten or fifteen years. For this reason the turbines are set twenty-nine feet below the present tail-water level. When the units are completed, sometime early in this year, they will go into operation supplying the electric power which is expected to pay for the cost of the Boulder Dam Project. Contracts have been let with half a dozen power companies in the Southwest for the sale of Boulder Dam electricity. There is no lack of market for this power.

As now planned, two more large units will go into operation about January 1, 1938. Subsequent units will be added as needed. When complete the Boulder Dam Power Plant will be the largest and finest hydro-electric plant in the world.